

Advanced Modular Power Systems (AMPS)

Active Technology Project (2011 - 2023)



Project Introduction

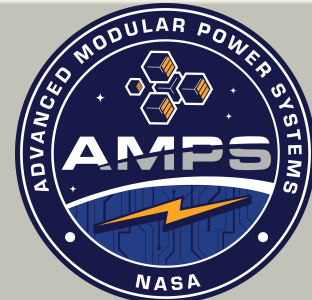
The Advanced Modular Power Systems (AMPS) project is infusing new technology into power systems and components and proving their capabilities through exploration-based ground demonstrations.

The AMPS technology portfolio includes the development of modular power units which, when combined with standardized interfaces, will provide commonality across a variety of exploration vehicles for future NASA missions. The project has developed the Modular Electronic Standard for Space Power Systems, which defines the form, fit, and function of each modular power unit for human exploration missions and systems.

Additionally, the AMPS technology portfolio includes the development of an autonomous power controller (APC) to manage electrical space power systems without a human operator in the loop. The APC provides 3 main functions:

- Energy management: Manage the on-board electrical power system to ensure safe and stable operations, all power system constraints are not violated, and power qualifications are met.
- Fault management: Detect and identify the size, location, and type of fault, and quickly isolate hazardous failures in the system. This enables the autonomous controller to take the proper corrective and facilitate system recovery.
- Contingency management: Manage the electrical power system configuration and create plans for distributing power during fault scenarios and ability to return the electrical power system back to nominal configuration/operation.

The AMPS APC team is collaborating with external partners in developing the APC capability for a lunar surface based electrical power utility. A collaboration with Sandia National Laboratories is focused on managing power of the lunar electrical power utility, which is made up of smaller islanded microgrids that contain their own power generation and energy storage. This hierarchical power controller enables the sharing of power between the islanded microgrids to ensure all higher level lunar surface objectives are met even during failure scenarios. The APC team is also working with the US Army on expandable and reconfigurable electrical microgrids that can seamlessly integrate dissimilar power sources to maximize electrical power availability. In this effort, the APC team will integrate the US Army developed Tactical Microgrid Standard (TMS) into an AMPS modular hardware based power system and evaluate the ability for TMS to support evolvable and reconfigurable electrical power systems. If this effort is successful, NASA will be able to leverage additional capabilities developed under the TMS effort and take advantage of DoD supply chain in developing power system components for the lunar surface.



AMPS Project Logo

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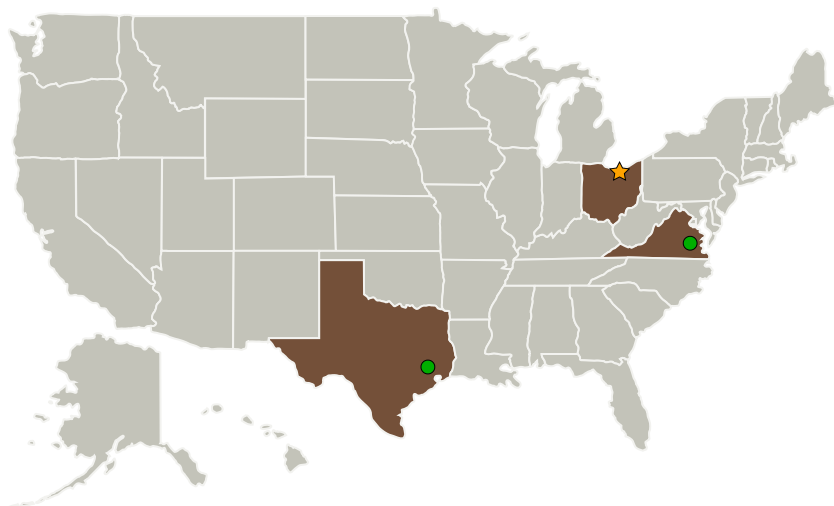


Anticipated Benefits

The AMPS project seeks to **transform future space power system architectures with a modular approach**, standardizing the power system at the electronics module level, and validating the modular approach through ground-based demonstrations. The anticipated benefits include opportunities to minimize power system maintenance operations, to improve power system availability, and to reduce the number of unique spare parts which necessary to enable sustainable future exploration missions and systems.

Additionally, through the autonomous power controller effort, the AMPS project seeks to **autonomously integrate dissimilar power sources to maximize power availability** for lunar microgrids. This work leverages important collaborations with Sandia National Laboratories and the US Army to develop power system capabilities for a sustainable lunar presence.

Primary U.S. Work Locations and Key Partners



Organizational Responsibility

Responsible Mission Directorate:

Exploration Systems Development Mission Directorate (ESDMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Exploration Capabilities

Project Management

Program Director:

Christopher L Moore

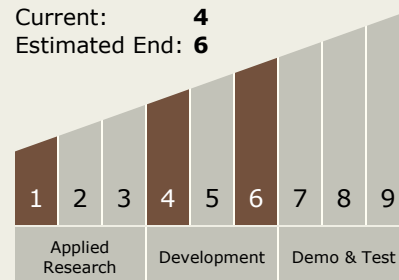
Project Managers:

Karin E Bozak

Jeffrey T Csank

Technology Maturity (TRL)

Start: **1**
Current: **4**
Estimated End: **6**



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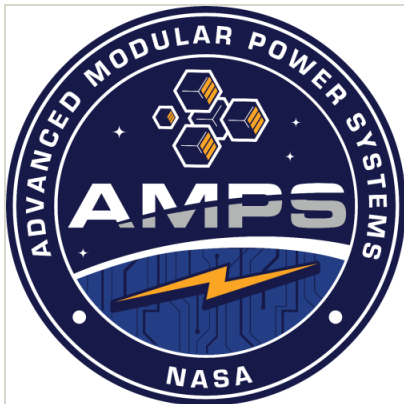


Organizations Performing Work	Role	Type	Location
★ Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations

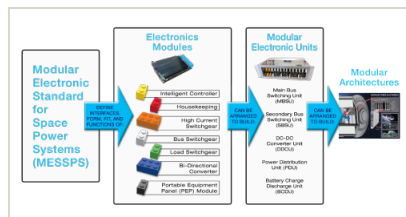
Ohio	Texas
Virginia	

Images



Advanced Modular Power Systems (AMPS) Project Logo

AMPS Project Logo
(<https://techport.nasa.gov/image/100993>)



Advanced Modular Power Systems (AMPS) Project Overview

This image describes the overall approach to implementing a modular power system architecture using AES Modular Power System technologies
(<https://techport.nasa.gov/image/100989>)

Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
 - └ TX03.3 Power Management and Distribution
 - └ TX03.3.1 Management and Control

Other/Cross-cutting:

- TX03 Aerospace Power and Energy Storage
 - └ TX03.3 Power Management and Distribution
 - └ TX03.3.2 Distribution and Transmission
 - └ TX03.3.3 Electrical Power Conversion and Regulation
 - └ TX03.3.4 Advanced Electronic Parts
- TX10 Autonomous Systems
 - └ TX10.1 Situational and Self Awareness
 - └ TX10.1.2 State Estimation and Monitoring
 - └ TX10.2 Reasoning and Acting
 - └ TX10.2.2 Activity and Resource Planning and Scheduling
 - └ TX10.2.4 Execution and Control
 - └ TX10.2.5 Fault Diagnosis and Prognosis

Continued on following page.

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Stories

Modular Power Systems Infusion Story
(<https://techport.nasa.gov/file/125300>)

Technology Areas (cont.)

└ TX10.2.6 Fault
Response

Target Destinations

The Moon, Mars, Others Inside
the Solar System

Supported Mission Type

Projected Mission (Pull)